A Continuation of the Diſcourſe concerning Vitriol, *begun in* Numb. 103. *ſhewing, That* Vitriol *is uſually produced by Sulphur, acting on, and concoagulating with, a Metal; and then making out, that* Allom *is likewiſe the Reſult of the ſaid Sulphur; as alſo evincing, that* Vitriol, Sulphur, *and* Allom, *do agree in the Saline Principle; and laſtly, declaring the Nature of the Salt in Brimſtone, and whence it is derived.*

THAT the Vitriolat Salt in *common Sulphur* differs little from the Salt in *Vitriol*, will appear evident to them, who will compare with the common Spirit, or Oyl of Vitriol, the Acidity of Sulphur afforded by Brimſtone inflam'd under a Glaſs-bell, which being rectified is not to be diſtinguiſh'd by any ſenſible property from the well-rectified Acidity, or Oyl of good Vitriol; and they may, I am confident, be ſafely ſubſtituted for each other, producing in Men and Metals the very ſame effects, being, in any apprehenſion, no leſs alike in their *internal* and ſecret, than in *external* ſenſible qualities.

The quantity indeed of Acidity, which is obtain'd in the ordinary ways of operation is very ſmall, a pound of Brimſtone not yielding above one Ounce, or ten Drachms, the far greater part being by the rapid Motion of the Flame ſublim'd in the Form of *Flores*, which differ not from the common Flowers. I have been often aſſur'd by a Kinſman of that admirable Mechaniſt *Cornelius Drebbel*, that his Uncle did, by the means of conveniently ſhaped Veſſels, ordinarily obtain out of a pound of good Brimſtone eight, and, in a very moiſt Seaſon, ten ounces of Acidity, and was confident he could, by improving the contrivance, recover the entire weight of the Sulphur; the moiſture of the Air acquired making abundant recompence for the avolation of what is incoagulable. I have my ſelf, by the means of ſeveral *Menſtrua*, reduced *common Brimſtone* into the form of an highly Acid corroſive Liquor, and even *Spirit of Niter*, or *Aquafortis*, well rectified, being digeſted on the Flowers of Brimſtone, then diſtilled in Aſhes, this repeated five or ſix times, after the laſt co-

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hobation there will remain with the Flowers near their weight of an acid Spirit, like that made by a Bell; the Spirit of Niter being ſcarcely changed from what it was before the operation: And, I ſuppoſe, that being reiterated frequently, eſpecially, if freſh Spirit be employed, the whole may be tranſmuted, abating ſome few earthly and metallick Particles; the ſulphureous being capable of a fluid Form, and are copious in Oyl of Vitriol, *Aquafortis*, and many other acid *Menſtrua*, eſpecially if any imperfect ſulphureous Minerals were imployed with the other ingredients in their production.

I once made out of Vitriol, common Salt, and Antimony, a Liquor clear as any Fountain-water, yet the Smell intolerably ſulphureous, continuing ſo many years: And true inflamable Sulphur may ſeveral ways be recovered out of Oyl of Vitriol, or Sulphur, many times rectified, and in appearance free from ſuch mixture. We formerly mention'd its ſeparation by means of vinous Spirits. Alſo, if mixt with Oyl of Turpentine, and diſtilled, at the latter end ſtore of Brimſtone will ſublime: I ſuppoſe, none will aſcribe this to the Vegetable Oyl, which is only the means of its ſeparation, being an appropriate *Menſtruum*, or diſſolvent of ſulphureous Bodies. This recals into my mind what I have often obſerv'd, (and I ſuppoſe it always happens) in the preparation of *Balſom of Sulphur* with the ſaid Oyl of Turpentine: After the Oyl is ſatiated with Sulphur, it lets fall ſtore of fair Cryſtals; an evident proof of its ſaline Nature: For, although theſe Cryſtals broken, within appear full of Sulphur, their outward parts or ſuperficies ſeem perfect *Salt*, by vertue whereof they are diſpoſed to cryſtallization. It may indeed be objected, that cryſtallization is not a ſufficient proof of a ſaline Nature, the eſſential Oyls (as they are called) of Anniſeeds, Fennel-ſeeds, and of many other ſubſtances being very prone to cryſtallize, where there is no ſuſpicion of their abounding with Salt. But this Objection is ſo far from invalidating my aſſertion, that it rather confirms it, moſt eſſential Oyls abounding no leſs with Salt than common Sulphur, into which I have often converted them without additament, or ſuſpicion of

Tranſmutation: Which, together with ſeveral other Experiments and Obſervations, induce me to embrace that lucky, or rather judicious, conjecture of the deſervedly admired *Carteſius*, *That* Sulphur *conſiſts of Saline Particles incloſed in ſtore of branched Oleaginous Matter, and may be predominant in ſome Subſtances, but is no where pure and ſeparate from the other Principles; for then it would immediately vaniſh into Air, being always mixt with either Salt, or Earth, and then it appears in a dry Form; or with Water and Spirit, and then in a Fluid.*

But to return whence we digreſſed: Nothing can more fully demonſtrate any truth, than the conſideration of the following Experiment doth the *Affinity*, I had almoſt ſaid, *Identity* of the *Saline* Principle in *Sulphur* and *Vitriol*. Take thin plates of Copper, cement them carefully with common Brimſtone, *ſtratum ſuper ſtratum* (as Chymiſts love to ſpeak) repeat the operation four or five times with freſh Sulphur; moſt of the Copper will be converted into Vitriol, which diſſolved in Water, and moſt of that evaporated, it yields very beautiful Azure Cryſtals. The ſame may be effected with *Iron*; or take the Acidity of Sulphur (corruptly called its Oyl) moiſten therewith filings of Copper, or Iron, then free them by Fire, or Air, from ſuperfluous moiſture, repeat this twice, or thrice, and afterwards with common Water, you may extract a fair Vitriol, which by the Chymiſts is called *Vitriolum Martis*, or *Veneris*, according as the one, or the other Mettal was imployed in order to its production; which ſame Mettals being diſſolv'd in any acid *Menſtrua*, and cryſtallized, are converted into Vitriol. This is ſignified unto us by the common name of Vitriol, vulgarly ſtiled *Cuperoſum*, quaſi *Cuprum eroſum*; that being the Mettal wherewith 'tis uſually aſſociated. Sulphur indeed is found mixt with moſt Mettals and Minerals, Gold and Silver not being excepted, the moſt expert Mineraliſts in *Peru*, accounting abundance of Sulphur an eſpecial ſign of rich Ore: And among the richeſt Ore of the mountain *Potoſi* * are ſuch quantities of Brimſtone, that the cavities and hollow places are preſently filled with flame, if

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* *See c. 19. of the 1ſt Book of Mettals, declaring the manner of their Generation, written in* Spaniſh *by* Alonſo Barba, *and tranſlated into Engliſh* Anno 1669.

a candle touch or come very near their ſides. Yet they do not ordinarily find Vitriol in mines of gold and ſilver (unleſs mix'd with other mettals) becauſe thoſe bodies are ſomewhat too compact for the ſulphureous ſpirit to diſſolve aſſiſted with a *ſmall* degree of heat; whereas all ores, which touch on cooper or *Pyrites* abounding in Sulphur, do alſo afford Vitriol; copper being an open body, and more eaſily ſoluble than any other mettal: For, it will preſently, though crude, diſſolve *in*, and give a deep tincture *to*, common Volatil urinous ſpirits; which cannot be affirmed of any other mettal, howſoever prepared; and therefore no wonder if it be by the ſteam of ſulphur ſo eaſily converted into Vitriol: And in the bowels of the Earth it is, I do conjecture, moſtly produced after this manner.

An acid ſalino-ſulphureous ſteam (ſuch we have proved that of common ſulphur to be) inſinuating it ſelf into a vein of copper, corrodes it, and uniting therewith becomes Vitriol. So it doth by mixture with iron, and other minerals; whence being waſhed by water, it produces *acidulæ* of divers kinds, according to the nature of the minerals, wherewith the acids is united. And that Vitriol and Vitriolate waters are thus produced, is hereby confirmed, that many ores and *Pyrites* being diſtilled *per deſcenſum*, yield abundance of common ſulphur; the remainder afterwards affords ſtore of Vitriol, although before calcination it would have yielded none; the fire enabling the ſulphur to corrode, and aſſociate with, the metallick parts; that which is without mixture of mettal, or which hath thereof a very ſmall proportion, continuing under the form of Brimſtone.

This to me ſeems the reaſon, why Vitriol and Brimſtone are uſually found together, thoſe minerals and pyrites that bound with one, being uſually impregnated with the other; Vitriol not being a diſtinct principle, but the genuin off-ſpring of ſulphur, its material cauſe, and fire and air the efficient cauſes of its production. I ſpeak of Vitriol generated *in* the bowels of the earth; for it *may be*, and *is*, often produced *above* ground by the aerial ſalt united with mineral ſubſtances, copiouſly contained in marcaſites, which it extricates, and concoagulating therewith becomes a Vitriol.

You will not, I ſuppoſe, be much ſtartled at theſe words, *Aerial ſalt*, after the credit you have lately given a diſcourſe concerning the *Volatil Salt of Vegetables*, which upon their Putrefaction or Arefaction expiring into the air, *that* muſt neceſſarily abound therewith, beſides abundance of the ſame ſubſtance, which tranſpires from animals, and is ſublimed by ſubterraneal fires, whereof I may hereafter render you a more particular account. I ſhall at preſent only affirm, that this *Aerial Salt*, which I have many ways procured, whilſt in the air, is altogether un-ſpecificate, I mean, freed from all union with, or determination by, any ſeminal principle; (the primordials of all *ſpecies* in the univerſe being, in my opinion, ſpermatical;) but being once at the command of the architectonick power of any *ſpecies*, whatſoever *that* be, it is by it, with other matter, determined in order to the formation and augmentation of the *Individuum*, and propagation of the *ſpecies*, and, upon the diſſolution of its dwelling, returns whence it deſcended. Beſides this, there is alſo in the air and acidity, as is evident in iron-bars, whoſe ſuperficies is thereby reſolved into a ſubtle *crocus*; alſo in the tarniſhing of poliſh'd mettals, where Pit-coals is much burnt, near unto and on the Sea, and where expoſed to certain winds; truths ſo common and obvious, that I need not expatiate on, or much labour to confirm, them.

This acid ſpirit with the ſalt,laſt mention'd,are inſtruments by nature, imployed in almoſt every operation; eſpecially the ſalt, without which no perfect animal can ſubſiſt a minute, and all vegetables deprived thereof do immediately decay. I ſhall in this diſcourſe have regard unto them only as they contribute towards the production of ſalts. Its well known, that ſeveral minerals and *Pyrites*, which are to the taſt altogether inſipid and elixiviated, would yield not a grain of ſalt; being expoſed unto the *Air* are reſolved into a powder, and afford ſome, allom, others Vitriol copiouſly. Sometimes the minerals require previous Calcinations, which opens and relaxes the *compages* of the bodies, ſo that the air may have more eaſy ingreſs. And it is, I think, by moſt allow'd, that, after all the ſalt is extracted out of earth impregnated with vitriol, allom or niter, the ſaid earth being expos'd a ſufficient time into the air, acquires freſh ſupplies, and that in ſuch quantity, that many have concluded (which I can neither contradict or confirm) than in an hundred or ſome few more years the earth would yield more ſalt than its whole bulk amounted to in the beginning of the operation; a great, if not the greateſt, portion whereof muſt be deriv'd from the air. And it is particularly remarkable in vitriol and allom, that their ſpirit being put into a commotion or fermentation by either heat or contrary-natur'd ſpirits, the glaſſes which contain them being well cloſed, although large and ſtrong, will be crack'd or broken in pieces; which ſeems to proceed from the expanſion of ſome of thoſe prodigiouſly active ſpringy particles, wherewith the air abounds, which together with the aerial ſalt were arreſted by the vitriolifiing principle, and ſet at liberty by the tumultuating liquor, the change of whoſe contexture might occaſion their diſmiſſion, the unbending of their ſprings, and the effects which thereupon enſue. But, whether the vitriolate *marcaſites* are only magnets, to attract and ſpecificat the aerial ſalt and ſpirit; or whether theſe are as well active, as paſſive, ſeparating, comminuting, and after combining with the mineral particles, ſo that the reſult is different from what either of them were before ſuch union, I leave unto farther enquiry: For, though I could ſay much on this occaſion, yet I ſhall defer it, until ſome few more experiments have enabled me to make more perfect diſcovery of a truth, which is not ſo obvious as moſt may imagine.

I ſhall now proceed to demonſtrate unto you the affinity between *allom* and *vitriol*; I mean, the *natural*, not common *factitious* allom; ſea-ſalt, alcalies, and urine being uſually imploy'd in its production. Now, *vitriol* not only in *England*, but in ſeveral other parts of the world, is ordinarily found in the ſame vein, and ſometimes in the ſame parcel that yields the allom: which may by ſeveral methods be ſeparated from each other. The mineral of *allom*, if mature, elixiviated yields it Salt preſently; if leſs mature, it requires previous calcination; if very immature, it muſt not only be burnt, but long expos'd unto the air. The cauſe whereof ſeems the very ſame with that we lately mention'd in our account of the production of *vitriol*; the *allom*, as *that* is, being produc'd by the ſulphurs acting *on*, corroding *of*, and concoagulating *with*, ſome mineral ſubſtance, which uſually partakes more of terrene and ſtony, than metallick, nature; although yet mettal is often found to be contain'd in the allom, ſtone, or ore. And that the ſulphur is the chief efficient and material cauſe of its production, appears from hence, that many allom-ſtones (as the vitriolate) diſtilled *per deſcenſum*, yield good brimſtone; and all allom, ſtones, or ore, during calcination, emit a ſuphureous ſteam. An inquiſitive naturaliſt of my acquaintance did gather from the very ſame rock, and that within a few inches of each other, vitriol, allom, and ſulphur; all of them excellent and perfect in their kind. Indeed they are ſo nearly allied, that I can by ſome pretty artifices (too long to be here deſcrib'd) convert allom into vitriol, or vitriol into allom, which ſhall be the ſame to all intents and purpoſes (as we commonly ſpeak) with the natural.

Allom diſtill'd into an acid ſpirit with copper or iron, becomes good vitriol; and *vitriol* freed from its metallick parts becomes aluminous; and diſtill'd, yields a ſpirit ſcarcely to be diſtinguiſh'd not only by taſte, but even by the moſt nice and accurate ſcrutiny, from that of allom. And (which doth in ſome meaſure illuſtrate this affinity) I have often obſerv'd rectified oyl of vitriol and ſpirit of ſulphur to coagulate and become ſolid tranſparent concretions, exactly reſembling allom cryſtallized, with which compar'd, I am confident, the moſt judicious eye, without the aſſiſtance of the palate, would find little difference.

Having analis'd *vitriol*, and ſhewed, that it is uſually produc'd by ſulphur acting on, and concoagulating with, a metal; and that *allom* is the reſult of the ſaid ſulphur, comprehended in, or united with, bodies leſs metallick and more terrene; and having, I think, fully evinced, that ſulphur, vitriol, and allom do agree in the ſaline principle, which is in all originally the ſame, perhaps a little chang'd by the bodies with

with which it is aſſociated: it remains, that I ſhould declare the nature of the ſalt in *Brimſtone*, and whence it is deriv'd.

Brimſtone conſiſts of *mineral* ſulphur, and an *acid* ſalt, which being united, it is no difficult matter to conceive, how it ſhould become volatil, if we reflect on *cinnaber* and *ſublimate*. In *one*, mercury is ſo diſguiſed by a little ſulphur, that it ſeems a mineral ſubſtance of another nature, and, abating the colour, not unlike antimony: In the *other*, ſalts very acid and fixt are rendered ſufficiently volatil. Now, whence the brimſtone ſhould derive its ſulphureous particles, will appear very obvious to them, who have obſerved, how much the bowels of the Earth abound with bituminous ſubſtances. What elſe feeds all the ſubterraneous fires? What an immenſe quantity thereof is lodged in the earth, will be atteſted by our large and numerous coal-mines, and by thoſe eruptions of bituminous ſubſtances in many quarters of the world, among which that, called *Napththa*, is ſo purely ſulphureous, ſo free from mixture with any other materials, that upon the very approach of fire or flame it is immediately inflamed, and ſcarcely to be extinguiſh'd, until wholly conſumed. As for the *ſaline* principle of ſulphur, I conclude it to be *common ſalt*, which, together with the *aerial* ſalt before mentioned, is the foundation of all ſaline ſubſtances in the univerſe. How it comes to be ſo much diverſified by ſtrong and violent heat, or long and eaſie digeſtions, as alſo by its acting *on*, and combinations *with*, particles of different nature, I ſhall at your next ſummons endeavour to make manifeſt, it not being an ungrounded fancy, but a perſuaſion derived from many experiments and long obſervation. I ſhall at preſent only aſſure you, in reference to the preſent diſcourſe, that I can with *common ſalt* make both *vitriol* and *allom*, hardly diſtinguiſhable from the natural.